Statement of Project Objectives

The Mississippian Leadville Limestone Exploration Play, Utah and Colorado – Exploration Techniques and Studies for Independents

Utah Geological Survey

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A. Objectives:

The objectives of this proposed study are to: (1) develop and demonstrate techniques and exploration methods never tried on the Mississippian Leadville Limestone in the Paradox Basin of Utah and Colorado, (2) provide the facies, hydrodynamic pressure regime, and oil show quality maps that can be used to target areas for exploration, (3) increase deliverability from new and old Leadville fields through detailed reservoir characterization, (4) reduce exploration costs and risk especially in environmentally

sensitive areas, and (5) add new oil discoveries and reserves in this under explored region.

The project will be conducted over two phases, each with specific objectives and separated by continue-stop **decision points** based results to date. The objectives of **Phase 1** (year 1) will be to conduct a case study of the Leadville reservoir at Lisbon field where we have a wealth of data in order to understand the reservoir characteristics and facies that can be applied regionally. This includes core description of cores and tying them to geophysical well logs to create "type" logs; reservoir characterization and diagenetic analysis using thin sections and various petrographic techniques; and construction of field maps and cross sections. The objectives of **Phase 2** (years 2 and 3) will be to conduct a low-cost field demonstration of new exploration technologies to identify potential Leadville oil migration directions and surface geochemical anomalies and to determine regional facies, identify potential oil-prone areas based on shows, and target areas for Leadville exploration. First, all well logs that penetrate the Leadville will be correlated using a correlation scheme derived from Lisbon type logs. We will conduct a regional hydrodynamic pressure regime study to identify potential Leadville oil migration directions. A key component of Phase 2, and the project, will be low-cost surface geochemical surveys (microbial, soil gas, iodine, and/or trace elements) conducted over known occurrences of Leadville oil. Maps will be constructed for regional facies, oil shows, and Leadville exploration trends. This work will include comparing both outcrop and modern analogs to core, mapping facies and thickness trends, constructing cross sections, and producing a quality of oil show map using low-

cost epi-fluorescene techniques. Finally, all results will be summarized in a report of best practices for Leadville exploration by independents.

These objectives are designed to assist independent producers and explorers who have limited resources but also have an interest in the potential of the Leadville reservoir. All project maps, studies, and results will be publicly available in digital or hard copy format through a proven technology transfer plan.

B. Tasks to be performed:

Task 1 – Lisbon Field Case Study

Task 1-1. Core description of Lisbon cores – Describe, photograph, and interpret petrophysical data and facies trends in the Lisbon field.

Task 1-2. Core profiles tied to geophysical well logs – Comparison of core properties to well logs, developing type logs for significant reservoir facies.

Task 1-3. Reservoir characterization/diagenetic analysis – Describe sedimentary structures, fractures, and determine diagenetic history. Includes thin sections, geochemical analyses, epi-flourescence, cathodoluminescence, carbon and isotope analysis, and SEM.

Task 1-4. Lisbon field maps and correlation – Develop a Lisbon field database, including reservoir microfacies and lithofacies, and construction of structure, reservoir properties, and facies maps.

Task 1-5. Technology transfer –

Subtask 1-5a. Technical Advisory Board: A Technical Advisory Board of independent oil company operators of Leadville fields or interested in exploring Leadville prospects will be established. The formation of the Technical Advisory Board ensures direct communication of the study methods and results with the Paradox Basin operators.

Subtask 1-5b. Stake Holders Board: A Stake Holders Board will be established composed of groups that have a financial interest in the study area, such as representatives from the Utah and Colorado state governments (Utah School and Institutional Trust Lands Administration [SITLA], Utah Division of Oil, Gas and Mining [DOGM], and Colorado Oil and Gas Conservation Commission [CO&GCC]), Federal Government (U.S. Bureau of Land Management [BLM]), the Utah Petroleum Association (UPA), and other entities.

Subtask 1-5c. World-Wide-Web Site: The UGS will maintain a web site dedicated to the project.

Subtask 1-5d. Industry Outreach Program: The UGS Industry Outreach Geologist (IOG) will set up technical displays at two major industry conventions: regional and national American Association of Petroleum Geologists (AAPG).

Subtask 1-5e. Talks and technical presentations at AAPG and other meetings.

Task 1-6. Project Administration & Management - The UGS will negotiate the final contract with DOE in consultation with other team members. The UGS will be responsible for ensuring that all required technical and financial reports are prepared and delivered to DOE as required in the final contract.

Decision Point 1 – Determine if the study of the Leadville Limestone reservoir Lisbon provides the necessary information to continue into Phase 2 - Demonstration of New Exploration Technologies and Regional Facies and Potential Leadville Limestone Exploration Trends

Task 2 - Demonstration of New Exploration Technologies, Regional Facies and Potential Leadville Limestone Exploration Trends

Task 2-1. Regional well log correlation – A regional well log correlation will be developed, and major horizons, facies, and sequence boundaries will be identified and correlated throughout the northern Paradox Basin and entered into GIS database.

Task 2-2. Regional middle Paleozoic hydrodynamic pressure regime analysis - Review all pressure data in the vicinity of the Leadville reservoir, with special attention to the Lisbon field area. The evidence for and implications of hydrodynamic drive in trapping oil will be investigated.

Task 2-3. Surface geochemistry (demonstration of new technology for the northern Paradox Basin) – Surface geochemical surveys will be conducted over one or more known occurrences of Leadville oil in the northern Paradox Basin. These surveys will consist of one or more combinations of the following techniques: microbial, soil gas, iodine, and trace elements.

Task 2-4. Outcrop analogs – Outcrop analogs for the Leadville play along the Grand Canyon National Park will be described. In the event the appropriate permits cannot be obtained, another site will be selected for the outcrop analogs. These descriptions will be tied to the Lisbon reservoir and other Leadville fields, in order to identify regional facies trends.

Task 2-5. Modern analogs – Representative modern depositional analogs for the Leadville play will be summarized from published reports and other information.

Task 2-6. Regional facies and oil show determination – The following activities will be conducted as part of Task 2-6:

Subtask 2-6a. Regional data compilation and core description: Compile information (core descriptions, photographs, and log characterizations) on the major facies encountered within the Leadville wells in Utah and Colorado.

Subtask 2-6b. Regional Leadville facies and thickness mapping: Map the generalized facies belts and thickness trends for the Leadville Limestone of the northern Paradox Basin.

Subtask 2-6c. Regional Leadville cross section construction.

Subtask 2-6d. Leadville quality of hydrocarbon show evaluation: Evaluate regional hydrocarbon shows using epi-flourescence techniques. The net product will be a regional Leadville quality of show map designed to identify Leadville oil-prone areas and migration patterns. The map will incorporate data and interpretations from Task 2-2.

Task 2-7. Best practices for Leadville exploration by independents – Based on the Lisbon field study and surface geochemical surveys, recommendations will be made on

the most economic and useful methods for the independent exploring the Leadville Limestone in the Paradox Basin and where these operators can target their exploration programs.

Task 2-8. Technology transfer –

Subtask 2-8a. Technical Advisory Board: (see subtask 1-5a).

Subtask 2-8b. Stake Holders Board: (see subtask 1-5b).

Subtask 2-8c. World-Wide-Web Site: (see subtask 1-5c).

Subtask 2-8d. Industry Outreach Program: (see subtask 1-5d).

Subtask 2-8e. Talks and technical presentations: (see subtask 1-5e).

Subtask 2-8f. Publications: The UGS will report all aspects of the project in a series of formal publications.

Subtask 2-8g. Core workshop/seminar: A one-day core workshop/seminar will be held at the Utah Geological Survey Core Research Center to examine core from both Lisbon field and regional wells.

Task 2-9. Project Administration & Management – (see Task 1-6).

C. Deliverables:

The UGS will submit the semi-annual technical, topical, and final reports in accordance with the "Federal Assistance Reporting Checklist." Other project deliverables are listed in table 1. These will be produced in both digital (pdf) and hard copy format.

D. Briefings/technical presentations:

Presentations to COR

As requested, the UGS shall prepare detailed briefings for presentation to the COR at the COR's facility in Tulsa, OK, or location to be determined at a later date. The UGS will explain plans, progress, and results of the technical effort.

DOE/NETL's Bi-Annual Contractor's Review Meeting

The UGS will provide and present a technical paper(s) at the DOE/NETL's Bi-Annual Contractor's Review Meeting in Tulsa, OK or other location to be determined at a later date.

Technical Presentations to Professional Organizations

Project results and recommendations will be presented by project team members to Technical Advisory and Stake Holders Boards, and during the AAPG annual national convention and AAPG regional meeting. Project team members may also make technical presentations to other professional organizations such as the Utah Geological Association and Rocky Mountain Association of Geologists.

The National Energy Technology Laboratory (NETL) in Tulsa, Oklahoma is the implementation office for the Department of Energy - Fossil Energy National Oil Program. Credit to the National Energy Technology Laboratory shall be given verbally and/or in writing when research, resulting from funding through this office is presented publicly. Additionally, reasonable advanced notice will be given to NETL regarding presentations and workshops.